BIOE 580/ BIOC 580/ CHBE 580
PROTEIN ENGINEERING
SPRING 2021

CLASS MEETING: 11:20AM - 12:40PM T/TR CT Online meetings

INSTRUCTOR

Dr Laura Segatori
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TEACHING ASSISTANT

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Office Hours: Friday 3.00-4.00pm or by appointment

TEXTBOOK

Class notes and reading assignments

Recommended: *Protein Engineering and Design*, edited by Sheldon J. Park and Jennifer Cochran
Proteins, Structure and Function by David Whitford
Molecular Biotechnology by Glick, Pasternak & Patten

While I do not require these books, the first text is tremendously useful for all who would like a written resource for course materials apart from the slides and papers on Canvas. The second is strongly recommended to those who need a good resource for protein properties and characteristics. The third is strongly recommended to those who need a good resource for recombinant DNA technologies.

COURSE DESCRIPTION AND TOPICS

This course is an in-depth study of the current methods used to design and engineer proteins. Emphasis on how strategies can be applied in the laboratory. Relevant case studies are presented to illustrate method variations and applications. Intended for graduate students.

Fundamentals of molecular biology and biochemistry will be introduced and discussed from the prospective of protein engineering and genetic engineering applications. Relevant peer-reviewed publications will be presented in class by the instructor and/or by the students and discussed to illustrate applications to current unmet needs in biomedicine and biotechnology.

OBJECTIVES:

- Developing an appreciation for the opportunities and challenges of the protein engineering profession
- Understanding the molecular and cell biology principles involved in the transfer and expression of genetic information
- Identifying genetic engineering tools to manipulate cell systems for desired research and industrial applications
- Understanding the basic differences between rational design and directed evolution of proteins.
- Understanding the differences among the technical procedures available for designing proteins de novo, and for rational design and directed evolution of proteins.
- Identifying the appropriate technology to create a library based on the size and diversity needed. Understanding the difference between random mutagenesis and recombination technologies for library creation.
- Understanding the requisite for high-throughput application of in vitro and cell-based assays. Optimization and validation of high-throughput screening assays.
- Working in teams on the application of protein engineering principles and applications to a biomedical or industrial problem of relevance, preparing a technical report and oral presentations.

OUTCOMES:

Students completing this course will learn to:

- Analyze the history and current trends of protein engineering, the grand challenges of this discipline, and the career options available
- Search and analyze journal articles in the topic of protein engineering
- Apply the molecular and cell biology principles involved in the transfer and expression of genetic information to the solution of research problems, particularly those related with the students' own graduate project.
- Use genetic engineering tools for the manipulation of cell systems for desired research and industrial applications.
- Identify the appropriate technologies for the creation of sequence diversity for the solution of a specific research problem or application, with particularly attention to understanding the differences among rational design and directed evolution, and mutagenesis or recombination-based techniques.
- Design, optimize and validate assays for high-throughput screening.
- Work in teams on the application of protein engineering principles and applications.

CLASS ATTENDANCE

It is expected that students attend all lectures and participate in class activities and discussions. Although class material will be mostly posted on the class website, attending class will be necessary for its analysis and understanding. In addition, students will be asked to present and to assess other students' presentations.

- All students who live four or fewer time zones away are expected to attend every class synchronously, via Zoom
- All students who are living where the time zone is >4 hrs from the central time zone are expected to either attend class synchronously via Zoom, to watch recorded lectures (posted

on canvas), or to work out in advance with the instructor a suitable solution for asynchronous attendance.
- Students attending class synchronously via Zoom are expected to arrive to class on time (e.g., within 5 minutes of start time).

CLASS PARTICIPATION

- Students are expected to be actively engaged in the classroom. Please keep your video camera on and microphone muted, unless you wish to ask a question. You may also use the chat to post comments and raise your hands when you have questions or would like to participate. Students needing accommodation for using their camera or microphone should contact the instructor at the beginning of the semester to discuss and work out needed adjustments.
- Active engagement is an essential component of the learning process. Participation in online courses includes active reading and discussion within online forums and activities during the week in which the class is engaged with the same content. Students are expected to log into the course, monitor course discussions, and engage as appropriate for the course several times a session.

OFFICE HOURS

Remote office hours will be conducted via Zoom by the instructor and by the teaching assistants. Zoom meetings will be accessible from Canvas.

When you arrive for remote office hours, please be patient if the instructor is meeting with another student. Type your name in the Chat window and briefly state the topic or question you would like to discuss.

If you live in a time zone that makes it difficult to attend the weekly posted Zoom office hours, email the instructor to make an appointment.

COURSE RESOURCES

All course materials will be posted to the course Canvas site.
Do not rely solely on posted slides for notes - they do not contain all covered material and will need to be supplemented with your own notes

TECHNOLOGY RESOURCES

- Students must have a working computer with a video camera, speaker and a microphone, and a working internet connection that allows them to be on video. Students should contact the Dean of Undergraduates if they have concerns about meeting this requirement. Graduate students should contact their department.
- If your computer/phone has no webcam/microphone, which are needed to complete some assignments, please let the instructor know as soon as possible and contact the Dean of Undergraduates if you need to request support via the Access and Opportunity Portal (HTTPS://AOP.RICE.EDU/APPLICATION.

GRADING POLICY:

10% Journal Club Presentation and Discussion Participation
25% Design Challenges
30% Midterm Exam
35% Final Project

Midterm Exam: The exam will be written and may consist of problem sets, short answer, essay, multiple choice, and/or true/false questions. The midterm exam will be held during normal class hours.

Final Project: A project in the form of a written protein engineering proposal will be assigned in lieu of a final exam. Intermediate due dates for portions of the project (e.g. selection of a topic, or submission of an abstract) will be given at the time the project is assigned. No late projects will be accepted.

Design challenges will be assigned as case-study based projects, to be worked on within small groups, and any written report or presentation slide deck will be turned in by the beginning of the class period unless otherwise stated by the instructor. Teams will be graded according the rubric provided by the instructor; peers will also provide feedback using this rubric, but the peer evaluations will not count toward the grade. Each team member will receive the same grade as the rest of the team. Further details on the design challenges will be provided later in the quarter.

Journal club presentation and discussion participation: Each student will present to the class one relevant article in a journal-club format (article to be chosen from a list provided by the instructor). The presenting student will also be asked to provide guiding questions for discussion, and the article will be required reading for all students before the appropriate discussion day. Active participation in the journal-club discussions is expected and required. Further details on the journal club presentation assignment will be provided separately. Students will be graded according the rubric provided by the instructor; peers will also provide feedback using this rubric (but the peer evaluations will not count toward the grade).

For all assignments, the instructor reserves the right to regrade the entire assignment if the student requests a regrade of a particular aspect of the assignment.

PREREQUISITES

There are no prerequisites for this course. It is strongly recommended, however, that students have been exposed to the fundamentals of molecular biology, cell biology, and basic recombinant DNA technologies. If uncertain, students should contact the instructor (segatori@rice.edu) to learn more about the course and decide whether they have the appropriate background.

PLAGIARISM AND HONOR CODE

Plagiarism is the undocumented inclusion of someone else's work within your work, and besides damaging your education, also violates Rice's Honor Code. The consequences for a Rice Honor Council violation typically range between an F in the course to a 2-semester suspension from Rice. We take plagiarism very seriously, be sure that you understand what an appropriate level of collaboration is before sharing information with a colleague. Please do not hesitate to contact the instructor for an explanation of what constitutes an Honor Code violation. Information about the Rice Honor System can be found at http://honor.rice.edu/

PRIVACY AND CONFIDENTIALITY

In line with FERPA requirements, recorded classroom discussions involving students will be available only to students officially registered and enrolled in the class. If you have concerns about appearing on these recordings, please contact the instructor ahead of time.

SPECIAL NEEDS

Any student with a documented disability seeking academic adjustments or accommodations is requested to speak with the instructor during the first two weeks of class to discuss the best way to meet the student's needs. All such discussions will remain as confidential as possible. Students with disabilities will need to also contact Office of Disability Support Services. The ODSS can help you document your needs and create an accommodation plan to ensure appropriate accommodations (disclosing your condition or diagnosis to course instructors may not be required).

SEXUAL MISCONDUCT IN ONLINE COURSE COMMUNITIES

Rice's Sexual Misconduct Policy applies in all Rice online courses. Examples of sexual misconduct behavior in an online environment are text-based or image-based discussion posts of a sexual nature that are severely offensive or repetitive, unwelcome contact in or outside the course, etc. If you experience sexual misconduct in this course or outside of it, contact the instructor and/or the Office of Sexual Violence Prevention and Title IX Support via email at titleixsupport@rice.edu or call (713) 348-3311.